

**PRELIMINARY**  
**Health** 81353  
**Assessment**  
**for**

---

CHEROKEE COUNTY-GALENA SUBSITE NATIONAL PRIORITIES LIST (NPL) SITE

GALENA, CHEROKEE COUNTY, KANSAS

FEBRUARY 3, 1989

---



S00082310  
SUPERFUND RECORDS



## THE ATSDR HEALTH ASSESSMENT: A NOTE OF EXPLANATION

Section 104(i)(7)(A) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, states "...the term 'health assessment' shall include preliminary assessments of potential risks to human health posed by individual sites and facilities, based on such factors as the nature and extent of contamination, the existence of potential pathways of human exposure (including ground or surface water contamination, air emissions, and food chain contamination), the size and potential susceptibility of the community within the likely pathways of exposure, the comparison of expected human exposure levels to the short-term and long-term health effects associated with identified hazardous substances and any available recommended exposure or tolerance limits for such hazardous substances, and the comparison of existing morbidity and mortality data on diseases that may be associated with the observed levels of exposure. The Administrator of ATSDR shall use appropriate data, risk assessments, risk evaluations and studies available from the Administrator of EPA."

In accordance with the CERCLA section cited, ATSDR has conducted this preliminary health assessment on the data in the site summary form. Additional health assessments may be conducted for this site as more information becomes available to ATSDR.



## PRELIMINARY HEALTH ASSESSMENT

Cherokee County-Galena Subsite NPL Site  
Cherokee County  
Galena, Kansas  
February 3, 1989

Prepared by:  
Office of Health Assessment  
Agency for Toxic Substances and Disease Registry (ATSDR)

### Background

The Cherokee County site is listed by the U.S. Environmental Protection Agency (EPA) on the National Priorities List (NPL). The Galena Subsite is one of six subsites designated by the EPA within the Cherokee County NPL site. The Galena Subsite is located in the southeast corner of Cherokee County. The subsite encompasses about 24 square miles in and around the City of Galena, Kansas. Mining for lead and zinc ores and smelting operations, in the Galena area, began in 1876 and 1890's, respectively. Mining and smelting activities ceased in the 1929's and 1960's, respectively. During this period, mine wastes resulting from shaft excavations, ore milling processes, and smelter operations had been disposed of on the ground near mine shafts and former mill sites. About 1.5 square miles of land in the Galena Subsite are covered with mine wastes. In addition, mine wastes have been left in underground mine shafts. Access to the contaminated areas are not restricted.

The land uses in the Galena Subsite are residential, commercial, light industrial, agricultural and livestock land, scattered woodlands, and abandoned mine land.

Elevated levels of heavy metals were found in ground water from shallow private drinking water wells (see Environmental Contamination and Physical Hazards Section below) at the Galena Subsite during 1985-1986 monitoring. Subsequently, in 1986, the EPA installed individual household treatment units at those residences whose drinking water supply exceeded primary drinking water standards. Before and after monitoring of the well water was conducted to evaluate the operation of the treatment units. In addition, because of the contamination found in the Galena private wells, a county-wide well inventory and water supply monitoring program was initiated in 1987 for private and municipal wells.

The following documents were reviewed by ATSDR for this Preliminary Health Assessment: Final Draft Phase I Remedial Investigation Report for Cherokee County Galena Subsite, April 23, 1986; Final Draft Phase I Remedial Investigation Report Air Quality Supplement for Cherokee County Galena Subsite, August 1, 1986; Final Draft Alternate Water Supply



Operable Unit Feasibility Study for Galena Subsite Cherokee County Site, November 4, 1987; Final Technical Memorandum Site-Wide Water Supply Inventory Cherokee County Site, November 25, 1987; Final Draft Groundwater and Surface Water Operable Unit Feasibility Study for Galena Subsite Cherokee County Site, February 26, 1988; Environmental Protection Agency and the Centers for Disease Control, August 1986, A Citizen's Guide to Radon; Casarett, C.D., Amdur, M., and Doull, J., Toxicology--Basic Science of Poisons, 3rd ed., 1986; and, Godish, T., Air Quality, Lewis Publishers, Inc., 1985.

### Environmental Contamination and Physical Hazards

Maximum contaminant concentrations in the on-site areas consists of lead [3,880 parts per million (ppm) in surface mine wastes, 500 ppm in surface soils, 390 parts per billion (ppb) in private drinking water wells, 290 ppb in surface water from subsidence or open pit mine ponds, 67 ppb in other surface waters (creeks or rivers)]; cadmium [60 ppm surface mine wastes, 12 ppm in surface soils, 180 ppb in private drinking water wells, 200 ppb in surface water from subsidence or open pit mine ponds, 140 ppb in other surface water (creeks or rivers)]; and, chromium (total) [120 ppb in private drinking water wells]. Ground water from the City of Galena municipal drinking water supply wells was monitored for heavy metal contamination; lead and cadmium were not detected. Neither lead nor cadmium was detected in fillet samples from game fish; however, elevated levels of lead and cadmium were found in whole fish samples from forage fish in local surface waters.

Radon gas (which may not be site-related) was found in private residences at concentrations as high as 4.03 pico-Curies/Liter. The source of radon gas is probably the result of the natural production of this gas within the geologic units underlying the area because of the composition of these units. However, releases of this gas at the site occur naturally and also can be enhanced because of previous mining activities in the area.

Ambient air monitoring for particulates was conducted by the Kansas Department of Health and the Environment (KDHE) and by EPA in 1983 and in late August and early September, 1985, respectively. Monitoring results from these investigations did not indicate appreciable concentrations of heavy metals absorbed to particulates found in ambient air, near the tailings piles (chat piles), former smelter site, or other areas considered potential sources of heavy-metal-contaminated dusts. However, the EPA monitoring results may underestimate the ambient air concentrations of heavy-metal-contaminated dusts because the 1985 sampling was conducted during a period when precipitation was more than twice the normal value for that period. In addition, the average wind speed for the 1985 sampling period was 2.7 miles per hour (mph) which was well below the average for August and September 1984 (i.e., 7 and 9 mph, respectively). Information regarding the meteorological conditions during the 1983 KDHE sampling period was not provided in the documents reviewed





for this Preliminary Health Assessment. A sieve analysis of chat samples, and subsequent analytical evaluation, to determine the concentrations of heavy metals in varying chat particle sizes, detected elevated concentrations of lead (4,700 ppm), zinc (5,800 ppm), and cadmium (20 ppm) in particles less than 38 microns (400 mesh) in size. Because the smallest mesh size used for this analysis was 400, the concentration and percent mass of respirable size particles (i.e., less than or equal to approximately 2.5 microns-See Evaluation and Discussion Section) in the samples cannot be determined.

Open mine shafts or tunnels and areas of current or potential ground subsidence may pose a hazard, which may result in physical injury, to children or adults who play or recreate in these areas. In addition, some of the subsidence areas are partially or completely filled with water which may increase the hazard posed by these areas.

#### Potential Environmental and Exposure Pathways

The Potential Environmental Pathways at the Galena Subsite are:

1. Rainfall infiltration, and surface and ground waters move through the surface and underground mine wastes which creates acid mine drainage. Dissolved heavy metals in the acid mine drainage are then transported from the contamination source via surface and ground water flow to the Spring River, Short Creek, and Shoal Creek. Most of the drainage from the contamination source to the Short Creek is via the Owl Branch tributary.
2. The natural hydrogeology of the subsite area has been extensively altered during the years of mining activities. The ground water flow patterns are controlled by faults, fractures, mine workings, shafts, and tunnels which act as preferred conduits for water flow. Hence, because of the unpredictable ground water flow patterns, all private/municipal wells (especially wells completed in the shallow aquifer) in the Galena Subsite (and Cherokee County Site) are assumed to have the potential to be impacted by site-related contamination.
3. Air emissions from the former smelter could have transported lead contaminated particulates to residential and public areas located around the former smelter operations. In addition, because the most recent ambient air monitoring data for particulates (1985 EPA investigation) may underestimate the heavy metal contaminant concentrations in ambient air, and there is no apparent vegetative cover on the tailing piles, it cannot be determined definitively if the air pathway is of concern. Hence, it is warranted to assume that the potential exists for appreciable concentrations of heavy-metal-contaminated fugitive dusts to be entrained into the air media and transported away from the source areas to potential receptors.



4. Given the extensive mining activities in the past, the potential for significant releases of radon gas from the subsurface into the ambient air does exist (which may not be site-related). In addition, these former mining wastes could contain radionuclides which can be transported in the ground water or surface waters away from the source areas.

5. Fish from the creeks and rivers in the subsite area have the potential for bioaccumulation of heavy metals in their tissues. In addition, bioaccumulation may (1) occur in plants grown on contaminated soils or irrigated with contaminated surface or ground waters, (2) livestock and their products which are fed potentially contaminated plant materials and/or watered with contaminated surface water, or (3) other identified local consumable plants and animals.

Given the potential environmental pathways above, the potential human exposure pathways of concern are:

1. Ingestion of contaminated soil or mine wastes by children or adults playing or recreating in contaminated areas.
2. Ingestion of contaminated household dust.
3. Inhalation of dust-entrained contaminants or radon gas (which may not be site-related). Children or adults who frequently play or recreate (i.e., motorbike riding) on the mine tailings (chat) piles may incur significant inhalation exposure to lead and cadmium, which were detected in appreciable concentrations in chat particles which may be of respirable size (i.e., less than or equal to 2.5 microns), because of dust produced during these activities. Motorbike riding, and other recreational activities on the tailings piles, may enhance the milling process of the tailings into finer, respirable size particles, hence, increasing the potential for appreciable exposure to heavy-metal-contaminated dusts.
4. Dermal exposure to contaminated soils, mine wastes, and/or contaminated surface water.
5. Ingestion of contaminated surface water while swimming.
6. Ingestion of potentially contaminated foodstuffs.
7. Ingestion of and dermal contact with contaminated ground water from any private wells still being used for potable water supplies.

#### Demographics

The City of Galena has a population of about 3,588 persons (1980 census). An estimated 1,050 persons live outside the City of Galena in the area.



## Evaluation and Discussion

The Cherokee County Site, in its present state of contamination, poses a concern to public health. Lead and cadmium in surface soil, surface water, and ground water, are found at levels that are of public health concern. Children are the main sensitive subpopulation of concern, because of their potential exposure to contaminated soil and surface water. Lead is absorbed via the gastrointestinal tract more efficiently in children than in adults (Casarett et al., 1986). Chronic low-level exposure (oral) has been known to result in irreversible central nervous system (CNS) dysfunction and adverse neurobehavioral effects. Because lead and cadmium have very similar toxic effects in multiple organ systems, each may be considered to potentiate the toxicity of the other resulting in possible additivity or possible synergistic effects.

If any residences are using ground water as a source of drinking or domestic supply, these individuals may potentially be exposed to concentrations of cadmium and lead through ingestion of or dermal exposure to the ground water, which may adversely affect their health.

Since access to areas which pose a hazard at the site is poorly restricted, the potential exists for serious physical injury or death as a result of falling into one of these open tunnels (shafts) or subsidence areas. This is of particular concern for persons engaged in recreational activities (e.g., hiking, exploring, motorbike riding) in the area. In addition, the potential exists for serious injury or death as a result of structural collapse on persons entering these areas.

The acidity (low pH) in many of the surface waters and acid drainages may pose a potential for ocular irritation following exposure to these sources. The potential also exists for dermal irritation or damage as a result of such exposure. However, dermal injury is dependent on both the pH and ionic makeup of the exposure medium.

Radon (which may not be site-related) was detected in three private residences at or near concentrations of EPA's action level of 4.0 pico-Curies/L. EPA's Office of Air and Radiation and the Centers for Disease Control (1986) considers concentrations of 4.0 pico-Curies/L to be average or slightly above average for residential structures. Although exposures in this range do present some risk of additional lung cancers, reductions of levels this low may be difficult, and sometimes impossible, to achieve. In addition, if monitoring data is about 4.0 pico-Curies/L to 20 pico-Curies/L, follow-up monitoring is recommended. EPA's Office of Air and Radiation and the Centers for Disease Control (1986) recommend that radon detectors be exposed for one year, or that measurements be made no more than one week duration during each of four seasons.

In general, human defense mechanisms are adequate to remove inhaled particles in excess of 2.5 microns in diameter. Particles smaller than this are respirable--that is, they may enter and be deposited in pulmonary



tissue. Alveolar deposition of particles is most efficient in the range of 0.1 to 2.5 microns. The effective toxicity of these small particles may be greater than that of larger particles since the concentrations of toxic substances such as lead, zinc, chromium, etc., increase with decreasing particle size. Additionally, the enormous surface area of small particles allows for higher reaction and dissolution rates for toxic chemical species. Their relatively long retention in the alveolar region permits substances such as lead to be extracted and transported to other parts of the body (Godish, 1985). As previously indicated, because the smallest mesh size used in the sieve analysis was 400 (i.e., about 38 microns), the concentrations and percent mass of respirable particles cannot be determined without additional analyses. Since the presence of these particles cannot be quantified, the significance of this exposure pathway cannot be determined. Hence, actual public health implications of inhaling heavy metal contaminated respirable size particles currently cannot be evaluated.

ATSDR has prepared, or will prepare, Toxicological Profiles on the site contaminants.

#### Conclusions and Recommendations

Based upon the information reviewed, ATSDR has concluded that this site is of public health concern because of the risk to human health caused by the probable human exposure to hazardous substances at concentrations that may result in adverse health effects. As noted in the Potential Environmental and Exposure Pathways Section above, human exposure to heavy metals is probably occurring via ingestion, dermal, or inhalation exposure to contaminated surface soils, mine wastes, surface waters, or contaminated foodstuffs.

Based on the potential adverse public health implication posed by the site, the following recommendations are warranted:

1. Given the public health concerns posed by the Cherokee County-Galena Subsite, all efforts to restrict access to all known contaminated surface soils and mine wastes in residential and non-residential areas should be considered to prevent exposure to site-related contaminants. In addition, until remedial actions are completed, access should be restricted to the open mine tunnels (shafts) and subsidence areas should be considered to prevent exposure to the physical hazards posed by these areas.
2. Consider monitoring for radon gas (may not be site-related) contamination in the residences where previous monitoring detected radon gas concentrations that were at or near EPA's and CDC's action level of 4.0 pico-Curies/L. These data are necessary to evaluate the long-term public health implications associated with the inhalation of radon gas in these residences.





3. Implement proposed measures to control the potential migration of airborne contaminants. These measures will help ensure that nearby receptor populations are not exposed to significant levels of contaminant-laden soil or mine wastes via inhalation exposure. The EPA, in its remedial actions, is planning to institute control measures to reduce or to eliminate this potential human exposure pathway.
4. Consider identification of any private wells, in the subsite area, that are still being used as a source of potable water supply, and monitor, if applicable, for heavy metals and radionuclide contamination to characterize completely this potential human exposure pathway. The EPA, in its remedial actions, is planning to provide all residences with wells that have contaminated water, the opportunity to be supplied uncontaminated water from a public water supply source.
5. Continued monitoring of treated drinking water, for heavy metals and radionuclides, and maintenance of the installed treatment units, at those residences who had contaminant concentrations in their well water above the primary drinking water standards, should be considered. Such monitoring data are needed to determine the public health impacts. EPA, in its remedial actions, is planning to monitor these wells for heavy metals and radionuclides.
6. Continued monitoring of municipal wells for heavy metals and radionuclides should be considered. Such monitoring data are needed to evaluate public health impacts. This monitoring is required by State law (Kansas), and is performed routinely by the municipalities.
7. Identify any irrigation wells, private wells, or surface water bodies that are used as a source of water for livestock, gardens or crops. Monitoring of these water supplies for heavy metal contamination is necessary in order to characterize the potential for bioaccumulation of heavy metals in consumable livestock tissues, crops, other farm produce, or garden foodstuffs. In addition, crops or garden plants grown on soils already contaminated with heavy metals, because of other environmental pathways (i.e., deposition of wind blow dusts), should be identified. These soils should be monitored for heavy metal contamination to help characterize the potential for bioaccumulation of heavy metals in these foodstuffs. Such data are necessary in order to determine the public health implications of consuming contaminated biota.
8. Remedial Investigations and Feasibility Studies (RI/FSSs) are being planned for other EPA designated subsite areas within the Cherokee County NPL site. Further environmental characterization and sampling of the Cherokee County site, and other impacted areas, during the RI/FS investigations for the other subsites, should be designed to address the environmental and human exposure pathways discussed above. For additional guidance, see ATSDR's data need list attached to this report. When additional information and data become available, e.g., the completed RI/FSSs, such material will form the basis for further assessment by ATSDR, as warranted by site-specific public health issues.



9. In accordance with the Comprehensive Environmental Response, Compensation, Liability Act of 1980, as amended, the Cherokee County-Galena Subsite NPL Site, Cherokee County, Galena, Kansas has been evaluated for appropriate follow-up with respect to health effects studies. Since human exposure to site contaminants may be occurring, this site is being considered for follow-up health effects studies. After consultation with Regional EPA staff and State and local health and environmental officials, the Epidemiology and Medicine Branch, Office of Health Assessment, ATSDR will determine if follow-up public health actions or studies are appropriate for this site.

